BIO-SCIENCES AND AGRICULTURE

GRAZING FOURWING SALTBUSH (ATRIPLEX CANESCENS) UNDER DIFFERENT SUPPLEMENTAL FEEDING-REGIMES IN HIGHLAND BALOCHISTAN

Sarwat N. Mirza, Sarfraz Ahmad, Javed Afzal and M. Islam*

ABSTRACT

A grazing trial on fourwing saltbush pastures was conducted during summer and early fall of 1993 with three different grazing treatments (fourwing saltbush grazing with no supplementation, fourwing saltbush grazing plus 200 g of wheat-straw/head/day and fourwing saltbush grazing plus 500 g wheat-straw/ head/day) to investigate the grazing potential of fourwing saltbush pasture and devise management-systems for efficient utilization by sheep. Eighteen Harnai yearling rams, weighing 23±0.95 kg were used in the study in a randomized complete block design, divided into three groups, and the treatments were allotted to each group randomly. All the animals were grazed in the allotted plots of saltbush pastures in two grazing sessions; morning and evening.

The grazing trial lasted for 15 weeks from mid-June to the end of September. At the end of the grazing study, animals attained varying live weight gains (6.4%, 8% and 10%, respectively) in the three grazing treatments. Animals in the saltbush grazing treatment with no supplementation started losing weight after 10 weeks of the grazing period, while animals in the grazing treatments supplemented with 200 g wheat-straw/head/day maintained their body weights at the end of the study. The yearling rams in the grazing treatment offered 500 g wheat straw/head/day gained weight till the end of the study-period. Combining wheat straw with fourwing saltbush diet can thus offer a suitable grazing-regime for utilizing saltbush pastures during summer and fall seasons.

Key words: Balochistan, fourwing saltbush, grazing, intake, sheep.

INTRODUCTION

Sheep and goat-rearing is the main use of rangelands in highland Balochistan, and about 80% of the rural population live from the sale of small ruminants and their products (FAO, 1983). Out of the total area (34.7m ha) of Balochistan, 21 million ha or 60% is used for grazing (FAO, 1983). According to the latest census carried out in 1996, approximately 20.24 million sheep and goats have been reported in Balochistan (GOB, 1996). Rangelands are the major feed-source for these animals and about 90% of the feed-requirements are met from rangelands (FAO, 1983). However, due to high grazing-pressure and human disturbances, these ranges are unable to fulfil the feed-requirements of small ruminants, particularly during fall and winter seasons (Mirza et al., 1995). As a result of this feed shortage, animal-productivity is severely affected in the region (Akbar et al., 1990). To overcome this problem, research conducted at Arid Zone Research Centre has identified and evaluated various exotic fodder-shrubs, which are adapted under the prevailing environmental conditions (Mirza, 1995).

Atriplex canescens (Pursh) Nutt**.**, commonly known as fourwing saltbush, is a perennial halophytic exotic shrub, native to Western United States. It has shown potential as a promising fodder-shrub in areas having 250-300 mm annual rainfall in highland Balochistan (Mirza, 1995). The area has a typical continental Mediterranean climate, with cold winter and dry summer seasons (Kidd et al. 1988). Fourwing saltbush is extremely drought and cold-tolerant and provides high-quality browse, especially during summer and autumn months (Mirza, 1995; Thomson et al., 1997). This shrub produces leaves and twigs round the year. Fourwing saltbush can withstand moderate to heavy grazing-pressure (Rumbaugh et al., 1982), but, without suitable grazing-management, sustained production is not maintained (Jefferies and Pitman, 1986). Utilization of saltbush by animals is generally recommended after 18 to 24 months of growth (Ueckert, 1985). The crude-protein content in leaves of fourwing saltbush has been reported from 12 to 15 % during mid winter (Thomson et al., 1997).

It has been suggested that one acre of fourwing saltbush might provide the supplemental protein

* Arid Zone Research Centre, P.O.Box 63, Brewery Road, Quetta.

requirements for 0.5 to 1 animal unit during a 90-day period (Ueckert, 1985). Like other halophytes, fourwing saltbush has low energy-values because of high ash-contents. The energy-values are reported to cover only maintenance requirements of sheep, if they consume 1.2-1.5 kg DM/d (Le Houerou, 1992). But nutritionally, saltbush species contain high nitrogen-values, which have been reported to be as high as 2.5-3.5 % DM , i.e., 16-20% of crude protein (Le Houerou et al., 1982, 1983; Hassan et al., 1979). The digestibility of dry matter and of organic matter has been reported to be around 60% and 50%, respectively (Le Houerou et al., 1983). The digestibility of nitrogen has been reported to be around 65%, but the retention of nitrogen is only 55% (Benjamin et al., 1992). Atriplex, supplemented with grazing of native ranges, resulted in animal weight-gains of around 80 g/h/d (Le Houerou et al., 1983). Atriplex forage consumption, in addition to stubble or wheat-straw consumption, could lead to a well balanced ration and fulfil the nutritional requirements of animals in a productive grazing system (Le Houerou et al., 1991).

Various pen-feeding studies have already been conducted on fourwing saltbush, to investigate its potential as a forage-crop with other supplements (Thomson *et al.,* 1997). However, very little information is available on grazing-behaviour and grazing-management of this species. Therefore, the present study is conducted to investigate the grazing-potential of fourwing saltbush pasture and devise management-systems for efficient utilization of these pastures by sheep.

MATERIALS AND METHODS

The grazing trial on fourwing saltbush pastures was conducted during summer and early fall of 1993. Groups of three yearling rams of Harnai breed, weighing (23 ± 0.95 kg) were used, each in three different grazing-treatments viz; fourwing saltbush grazing with no supplementation (FWSB alone), fourwing saltbush grazing plus 200 g of wheat-straw/head/day (FWSB+200g WS) and fourwing saltbush grazing plus 500 g wheat-straw/head/day (FWSB+500g WS). There were two replications for each treatment. Two adjacent blocks (replicates) of sizes 35 x 152 m and 42 x 133 m, respectively, planted with fourwing saltbush shrubs at 2 x 2 m spacing during early summer of 1987 at Arid Zone Research Institute (AZRI), were used. At the start of the study, all leaves and young twigs from seven randomly selected plants in each plot were removed, weighed, and dried at 70°C for 24 hours, and multiplied by the total number of plants in each plot to determine DM forage biomass of fourwing saltbush available at the start of the study. About 1000, 747 and 687 kg DM/ha of fourwing saltbush was available at the start of the study in the plots assigned to the yearling rams for the three grazing treatments, respectively. Five randomly selected plants in each plot were protected by 1.5 x 1.5 m cages and the biomass of leaves was measured at the end of the study, in order to measure the off-take of saltbush leaves per head of sheep. The amount of saltbush consumed by sheep was measured at the end of the grazing-trial by the estimation of forage on caged (ungrazed) and grazed plants in each plot. The amount of forage contributed by understory (grasses and forbs) in each plot was also measured at the start of the trial, by harvesting above-ground biomass inside the 5, 1m^2 quadrats in each plot.

The two blocks were divided into three equal plots; each plot was grazed by three lambs from June 15 to September 29, 1993. Stocking-rate, calculated on the basis of saltbush forage biomass, was about 16 rams/ha/15 weeks. The yearling rams were grazed from 800-1200 h. and then 1700-1900 h. daily for 15 weeks. Known quantities of wheat-straw were offered to the groups in the two treatments (grazing plus 200g and 500g wheat straw/head/d, respectively) after the first grazing session i.e., at noon. The refused wheat-straw was measured the next morning before removing animals for grazing, to determine daily wheat-straw intake (g) for each group. Each group was offered a known amount of water throughout the day and night, and the daily water-intake in litres for each group was measured. Sheep were weighed at the start of the trial, then once a week in the morning until the trial ended. The weekly data on changes in body-weight (kg) and water-consumption (litres) by yearling rams were analysed, by using analysis of variance in a Randomized Complete Block Design.

RESULTS

Weekly body-weight change (kg) and daily water-intake (litres) of Harani yearling rams in different grazing regimes are shown in Fig 1 and Table 1. No

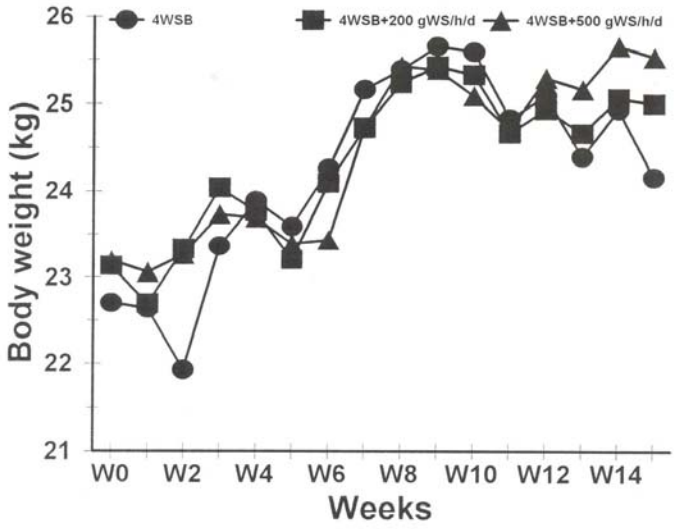

Figure - 1: Weekly body-weight changes in yearling Harani rams, starting June 16 (week 0) to September 29 (week 15), with three different grazing-treatments (4wsb grazing with no supplementation, 4wsb+200 gws/h/d and 4wsb+500 gws/h/d). Weekly body-weight changes did not significantly (P>0.05) differ among the three grazing treatments

significant (P>0.05) differences was observed in weekly body-weight change and water consumption among the three treatments. The daily intake of fourwing saltbush leaves from mid June to end of September by 23 kg rams in the three treatments was 466, 390 and 356 g DM and of chopped wheat-straw 0, 176, and 371 g DM, and the daily gains were 14, 18 and 22 g, respectively (Table 1). The understory vegetation (dry annual grasses and forbs) also contributed towards the total intake by the animals. About 36, 41 and 45 kg DM was available from dry annual and perennial grasses in the grazing plots. Animals consumed all the understory forage by the end of the trial. The total dry-matter intake by yearling rams (saltbush forage, wheat straw and understory forage) was 581, 698, and 871 g DM/head/day, respectively (Table 1).

During the grazing-trial, the total dry-matter of saltbush leaves and young twigs on offer was 1000 kg/ha, and the animals consumed almost 90% of the available forage by the end of the trial. The average daily consumption of saltbush forage in this trial was 466 g/head/day, while that of understory grasses was 114 g/head/day in the saltbush grazing treatment without supplementation. At this rate of consumption, the grazing trial established a stocking-rate of fourwing saltbush pasture as 15 yearling rams/ha for 15 weeks or 4.25 rams/ha/year.

The weight-gain data over 15 weeks period show an increase in weights by yearling rams in all treatments, with maximum cumulative increase (2.3 kg) in the treatment; FWSB+500 g wheat straw, followed by 1.9 and 1.5 kg increase in the treatments; FWSB+200g wheat straw and FWSB alone, respectively (Table 1). Animals in all three grazing-treatments showed maximum increase in their body weights, as well as average daily gain, during 10th week of grazing period; while animals in the saltbush grazing treatment without supplementation started losing weight, the animals in the other two treatments supplemented with wheat straw maintained their body weights during the next five weeks of grazing trial.

Off-take of saltbush leaves and twigs by the animals grazing on saltbush pasture alone was higher than that in the other two treatments. Animals consumed 49,41 and 37.4 kg/head of fourwing saltbush leaves and twigs during the study-period in the three treatments, respectively (Table-1). The water-consumption also did not differ significantly (P>0.05)

Table – 1: Grazing days, live weights (mean±SE) and average daily gains of sheep, off-take (mean±SE) of saltbush forage, and intakes of saltbush leaves, wheat straw and water (mean±SE) in three different feeding regimes

	Saltbush grazing alone	Saltbush grazing+ 200g WS/head/d	Saltbush grazing+ 500gWS/head/d
Grazing days	105	105	105
Initial live weight (kg)	22.7 ± 1.68	23.1 ± 1.87	23.2 ± 1.73
At week 10			
Live weight (kg)	25.7 ± 1.63	25.4 ± 2.18	25.4 ± 1.49
Average daily gain (g)	48.0	36.0	35.0
At week 15			
Final live weight (kg)	24.2 ± 1.53	25.0 ± 2.30	25.5 ± 1.53
Cumulative weight gain (kg)	1.5	1.9	2.3
Average daily gain (g)	14.0	18.0	22.0
Off-take saltbush (kg/head)			
Initial Biomass	54.0 ± 7.50	45.0 ± 8.33	42.0 ± 3.15
Final Biomass	5.1 ± 1.95	4.0 ± 0.06	4.6 ± 0.07
Off-take	49.0	41.0	37.4
Intakes (g DM/hd/d)			
Saltbush leaves	466	390	356
Straw	-	176	371
Grasses+ forbs	115	132	144
Total	581	698	871
Water Intake (l/hd/day)	3.7 ± 0.17	3.5 ± 0.15	3.7 ± 0.17

among the three grazing treatments. Animals consumed an average of 3.7, 3.5 and 3.7 litres of water per head/day in the three treatments, respectively (Table-1).

DISCUSSION

Though the yearling rams gained weight in all grazing-treatments during the 15 weeks of grazing-trial, maximum increase (10%) of the body-weight was achieved in FWSB+500g wheat-straw followed by 8% and 6.6% increase in the treatments: FWSB+200 g wheat straw and FWSB grazing alone, respectively. Animals in all grazing treatments attained maximum weight gain during the 10th week of the study period. The performance of animals in terms of body-weight gain after week 10 of grazing could have been affected due to less availability and intake of leafy foliage of saltbush towards the end of the study period. There could have been apparent decrease in forage-quality, as animals consumed more and more fibrous saltbush forage (twigs and small stems) towards the end of the grazing trial (Atiq-ur-Rehman et al, 1990b).

The results of this study suggest that, during fall and winter, when the native range vegetation goes dormant, and the animals start losing weight (Akbar et al., 1990, Atiq-ur-Rehman, et al., 1990a), grazing saltbush pastures could offer modest live-weight gains, especially when grazing is supplemented with 500g wheat straw/head/d. Rasool et al., (1993) suggested that inclusion of fourwing saltbush, up to 0.30% of the total diet, enhances straw-intake. In another study, which compared saltbush pasture grazing with native range grazing, range grazing with lucern hay and range grazing with barley grain, six months old lambs weighing about 12.5 kg gained an average of 6% of their body-weight by grazing saltbush pasture as their

sole diet over 10 weeks period. The study concluded that, under fourwing saltbush grazing alone, lambs not only maintain their body-weight but also gain some weight during early winter (Atiq-ur-Rehman et al., 1990b). Another study concluded that saltbush harvested at the beginning of winter season has a feeding-value below the maintenance requirement of sheep. This study concluded that sheep browsing on saltbush pasture, late in the season, would need to be fed wheat-straw for maintenance (AZRI/ICARDA, 1992).

The off-take value of saltbush foliage in the three grazing-treatments did not differ much. Animals in all grazing treatments consumed about 90% of the saltbush foliage on offer by the end of the study. This shows that established saltbush stands, in highland Balochistan of 1000 kg foliage DM/ha, can allow an off-take up to 750-900 kg DM of saltbush foliage at medium (75%) to heavy (90%) grazing-pressure during summer and fall period. At these off-take rates, saltbush pastures can be grazed at a stocking rate of 12-15 yearling rams/ha/15 weeks during summer and fall seasons.

The wheat straw intake by the animals in the two treatments; grazing saltbush+ 200 and 500 g wheat straw/head/d was 176 and 372 g/head/d, respectively. This shows that the animals offered 200g wheat straw/ head/d consumed 88% of the straw and the refusal in this case was the hard stem portion of straw rejected by the animals. In the treatment FWSB+500g wheat straw/head/d, animals consumed 75% of the wheat straw, which shows that the animals grazing saltbush forage during summer and fall seasons should be supplemented with at least 400g wheat straw/head/d in order to attain modest weight gains.

Ruminants grazing on saltbush diets may increase the water intake due to ingestion of large quantities of sodium and potassium chloride (Le Houerou, 1995). However, in this study the water intake was not much different in the three grazing treatments during the entire grazing period. Rasool et al., 1995, also reported low amounts of water intake by sheep fed fourwing saltbush leaves during December and related this to low salt contents in FWSB leaves. Different results have been reported for water intake on fourwing saltbush grazing alone and in combination with other supplementals (Thomson et al., 1997). These differences may be due to body weight, dry matter consumed, ash content of the diet, and ambient temperature.

Sheep grazing saltbush range have to avoid grazing during the period of hot weather to reduce stresses of a combination of heat and high salt ingestion and reduce water-demands significantly (ACSAD, 1987). The grazing of animals on saltbush pastures in the morning and evening may reduce the heat stress during summer season and extra water intake helps to excrete sodium and potassium chloride.

CONCLUSIONS

Browsing shrubs in forage reserves is considered to be the appropriate way to utilize saltbush pastures, though farmers can also cut and carry these shrubs to use as feed and get some fuelwood. The results of this study indicate that the sheep can maintain their body-weights if fourwing saltbush pastures are grazed during summer/early autumn, when growth of the shrubs is maximum and the nutritional quality is adequate. However, the results also indicate that modest weight-gains can also be achieved if supplements are offered with fourwing saltbush diet. In this case, the addition of wheat-straw to the diet of saltbush forage had shown better performance in yearling rams over a period of 15 weeks, as compared to grazing saltbush pasture alone. Combining wheat-straw with fourwing saltbush diet can offer a suitable grazing regime for utilizing saltbush pastures during summer and fall seasons. This system has an advantage over grazing saltbush pastures alone, in meeting both energy and protein requirements of sheep and allowing more persistency of the shrubs, as these are not subjected to heavy grazing when supplemented with alternate feed. These results are in agreement with those on penned sheep: that modest gains in live-weight can be expected if supplements are offered with fourwing saltbush diet (Thomson et al., 1997).

Currently, it is not known how farmers will manage their saltbush reserves and, therefore, it is important to expand the area and number of reserves on Government and private farms, so that these can be grazed by farmers' animals. Meanwhile, more detailed grazing-studies are needed, which will give researchers the information necessary to advise farmers on grazing-regimes that allow good off-take from saltbush reserves, without jeopardizing the persistency of the plants.

REFERENCES

1. ACSAD. 1987. Nutritive and Grazing Evaluation of Atriplex species for Sheep. Part One: nutritive evaluation. The Arab Centre for the Studies on Arid Zone and Dry Lands. ACSAD, Damascus, Syria. 242 pp.
2. Akbar, G., S. Rafique and B.R. Khan. 1990. Efficacy of water harvesting measures for the development of Range-Livestock sector in Balochistan. Proceedings of "National seminar on water resources development and its management in arid areas" Vol. 2 held at Quetta from October 6-8, 273-491pp.
3. Atiq-ur-Rehman., S. Rafique, A. Ali and M. Munir. 1990a. Nutritive evaluation of fourwing saltbush in growth and digestibility trials with Harnai lambs in upland Balochistan. Asian-Australasian J. Animal Sci., 3: 299-303.
4. Atiq-ur-Rehman , S. Rafique and R. S. Aro. 1990b. Fourwing saltbush as a winter maintenance forage for sheep in upland Balochistan. AJAS. 3 (2): 85-89.
5. AZRI/ICARDA. 1992. Highland Regional Programme: Annual Report 1991 of the MART/AZR Project. ICARDA, Quetta, Pakistan. ICARDA, Aleppo, Syria.
6. Benjamin R.W., E. Oren, E. Katz and K. Becker. 1992. The apparent digestibility of *Atriplex barclayana* and its effect on nitrogen balance in sheep. Anim. Production 54:259-264.
7. FAO. 1983. Report of the Assistance to Rangeland and Livestock Development Survey in Balochistan. TCP/PAK /0107, FAO Technical Cooperation Program, Food and Agricultural Organization of the United Nations, Pakistan.
8. GOB. 1996. Livestock Census Report. Government of Balochistan. Quetta.
9. Hassan, N.I., H.M. Abdelaziz and A.E. El Tabbah. 1979. Evaluation of some forages introduced to newly reclaimed areas in Egypt. World Rev. of Anim. Prod. XV 2: 31-35.
10. Jefferies, R.L and M..G. Pitman. 1986. Perspectives of the biology of halophytes in natural habitats in relation to forage production. In: Forage and fuel production from salt affected wasteland. Editors: Barrett-Lennard, E.G., C.V. Malcolm, W.R. Stern and S.M. Wilkins. Elsevier, Amsterdam. Pages 227-244.
11. Kidd, C.H.R., D.J. Rees, J.D.H. Keatinge, F. Rehman, A. Samiullah and S.H. Raza. 1988. Meteorological Data Analysis of Balochistan. Research Report No. 19. ICARDA, Quetta, Pakistan.
12. Le Houerou H.N., D. Dumancic, M. Eskileh, D. Schweisguth and T. Telahique. 1982. Anatomy and physiology of a browsing trial: a methodological approach to fodder shrub evaluation. 65.pp. Tech Paper N0.28 UNTF Lib. 18, FAO, Agr. Res. Centre, Tripoli, Libya.
13. Le Houerou H.N., G. Gintzburger and N. El Khodja. 1983. Chemical composition and nutritive value of some range plants and fodder shrubs of Libya. 14 pp. 4 tab. Techn. paper No 44. UNTF Lib. 18, FAO, Agr. Res. Centre, Tripoli, Libya.
14. Le Houerou, H.N., E. Correal and S. Lailhacar. 1991. New, man-made agro-sylvo-pastoral systems for the isoclimatic Mediterranean arid zone, 17 pp, IVth International Rangeland Congress, Montpellier (in press).
15. Le Houerou H.N. 1992. The role of saltbushes (Atriplex spp.) in arid land rehabilitation in the Mediterranean basin: a review. Agroforestry Systems. 18: 107-148.
16. Le Houerou H.N. 1995.Forage halophytes in the Mediterranean basin. Pages 115-136 in Halophytes and Biosaline Agriculture. (R. Choukar-Allah, C.V. Malcolm and A. Hamdy, eds.).Marcel Dekker, Inc. New York, Basel, Hong Kong.
17. Mirza, S.N. 1995. Fourwing saltbush-A multi-purpose shrub for the arid highlands of Balochistan. Arid Zone Research Institute. Pakistan Agricultural Research Council, Quetta. 18pp.
18. Mirza, S.N., G. Akbar and I. Begum. 1995. Land degradation and its control in highland Balochistan. Progressive Farming. Vol 15(2): 46-51.
19. Rumbaugh, M.D., D.A. Johnson and G.A. Van Epps. 1982. Forage yield and quality in a great basin shrub and legume experiment. J. Range Manage. 35: 604-609.
20. Rasool, E., S. Rafique and E.F. Thomson. 1993. Nutritive value of fourwing saltbush (*Atriplex canescens*) in Balochistan, Pakistan. Pages 70-74. In Annual report 1992. Pasture, Forage and Livestock Programme, ICARDA, Aleppo, Syria.
21. Rasool, E., S.Rafique, I.U. Haq, A.G. Khan and E.F. Thomson. 1995. Impact of fourwing saltbush on feed and water intake and on blood serum profile in sheep. Science Technology and Development. Vol.14(No.4):11-14.
22. Thomson, E.F., S.N. Mirza, S. Rafique, J. Afzal, I. Rasool, Atiq-ur-Rehman, M. Ershad, A. Hussain, G. Akbar and A.S. Alvi. 1997. Utilization of Fourwing saltbush for the Arid Rangelands of Highland Balochistan, Pakistan. In: N. Haddad, R. Tutwiler and E. Thomson (eds.). Proceedings of Regional Symposium on Integrated Crop-Livestock Systems in the Dry Areas of West Asia and North Africa held at Amman, Jordan from 6-10 November, 1995. ICARDA, Aleppo, Syria. 572 p.
23. Ueckert, D.N. 1985. Use of shrubs for Rangeland Revegetation. In: Proceedings of the International Ranchers Roundup. Laredo, Texas. Editors: L.D. White, D.E. Guyn, and T.R. Troxel. Texas Agricultural Extension Service. Pages 190-196.